

Remarks

Acceptance and favorable action therefor of this Amendment is respectfully requested. (An authorized credit card payment form covering the fee amount for the two-month extended time period for filing this Amendment is enclosed herewith.)

Several revisions are being implemented in the earlier-submitted Substitute Specification to remove discovered informalities therein. Acceptance and entry therefor of the same is respectfully requested.

By the Amendments presented hereinabove, claims 1, 5 and 7 are being further amended in consideration of rendering the claimed subject matter, including claims 1-2, 4-9, 11 and 13-14 which are directed to the previously elected species (e.g., Embodiment I of Figs. 1-10), allowable.

Claim 7 was amended to remove the standing objection thereto. Namely, the expression "said passage ..." was amended to the expression "said injection port ..." in order to maintain consistency with the similar expression contained in intervening claim 5, to which it refers. Since the matter raised has now been rendered moot, reconsideration and withdrawal of the objection to claim 7 is respectfully requested. Additionally, the relating expression in claim 5 has been amended in order to remove unnecessary, duplicating language directed thereto. An editorial revision was implemented therein, also, in order to improve the readability of the descriptive language. This particular featured aspect of the invention is discussed on page 18, the second paragraph, of the Substitute Specification in conjunction with Fig. 3 of the drawings (see also Fig. 8 and the related discussion on page 27, beginning in line 1, of the Substitute Specification).

Base claim 1 was also amended in consideration of removing all previous concerns directed thereto such as detailed under item 3, bridging pages 2 and 3 of the standing Final Office Action. Specifically, the previously standing expression "characterized in that said back surface of said semiconductor chip is defined by spin-etching a surface opposite to said semiconductor chip so that ... " has been further clarified in a manner consistent with the related description in the Specification. That is, this portion of the claimed subject matter is intended to cover a semiconductor device, for example, in connection with a TCP (tape carrier package), in which the thickness of the semiconductor chip is reduced to less than the thickness of the tape carrier to permit it to be disposed within the device hole in the tape carrier and in a manner which allows a lead of the tape carrier to be electrically connected easily to an external terminal (e.g., Au bump electrode 2a in Fig. 1) of the chip, the reduced thickness of the chip being defined by spin-etching of the back surface of the semiconductor chip. Such featured aspect as it relates to the thinning of the semiconductor chip is now clearly set forth in base claim 1, consistent with the related description in the Specification. According to the invention, the semiconductor chip (e.g., 2 in Fig. 1) is made smaller in thickness than the tape carrier through employing a polishing process such as spin-etching on the back (rear) surface of the chip. The semiconductor chip can be thinned considerably by spin-etching techniques and, also, the back surface of the chip is smoothed-out by the polishing action process therefor. As a result, not only is the chip able to be sealed completely within the device hole by a resin seal but, moreover, problems such as cracking of the structure are avoided and improved resistance to bending stresses of the TCP is realized. (Page 7, line 23, to page 8, line 7; page 22, lines 7-25; and page 30, lines 6-14,

of the Substitute Specification.) In view of the above-noted revisions to base claim 1, any ~~an~~ previously existing concerns, such as under item 3 of the Final Office rejection under 35 USC §112, second paragraph, of base claim 1 as ~~of~~ the corresponding dependent claims thereof, is traversed and as ~~er~~ation and withdrawal of the same is respectfully requested.

In accordance with the amendments presented hereinabove, base claim 1 ~~s~~ now been further revised to further highlight the particularities of the subject matter being covered including in consideration of further highlighting the distinguishing aspects of applicants invention over the teachings of the art documents, as cited in the Final Office Action rejections. Specifically, the language of claim 1 further highlights that the "tape carrier" of the present invention is now set forth to include a base layer (1a) and a lead portion bonded thereto (e.g., the thin film layer associated with the copper leads 1c in Fig. 1). As is clearly seen with regard to Fig. 1 of the drawings, for example, it is noted that the tape carrier 1 is inclusive of tape base 1a, adhesive 1b, leads 1c and solder resist 1d. Also according to claim 1, the sealing of the thinned semiconductor chip now calls for achieving a thickness at the resin sealed location of the device to be equal to the combined thickness of both the base layer and the lead portion of the tape carrier. With regard to Fig. 1 of the drawings, it is noted that the thickness D1 of the sealed resin (at the location of the device hole, where the chip is embedded) is equal to the thickness D2 of the tape carrier 1. In accordance with the present invention therefor, it becomes possible to achieve a total thickness of the, for example, TCP to be that of the thickness of the tape carrier 1. (Page 25, lines 11-18; and page 30, lines 15-21, of the Substitute

Specification.) Discussion will now turn to the outstanding art rejections.

According to the standing Final Office Action, claims 1, 2, 4, 5-8, 11 and 14, insofar as definite, stand rejected under 35 USC §103(a) over the teachings of Haghiri-Tehrani et al (USP 4,829,666); claims 9 and 13 stand rejected under 35 USC §103(a) over Haghiri-Tehrani et al (supra) in view of Nakamura (USP 5,729,051) and claims 5-8, also insofar as definite, stand rejected under 35 USC §103(a) over Haghiri-Tehrani et al in view of Ueda (USP 5,196,197). It is submitted, the invention according to independent claim 1, as now further amended, and further according to the above-named dependent claims thereof, not only was not disclosed nor suggested by Haghiri-Tehrani et al, but, moreover, could not have been suggested in the manner as that argued in the above-named rejections. Therefore, insofar as presently applicable, these rejections are traversed and reconsideration and withdrawal of the same is respectfully requested.

As discussed earlier in these remarks, base claim 1 was amended for purposes of more clearly defining the featured aspects of the claimed subject matter including in terms of further highlighting the patentable differences of the invention even over the combined teachings of the above-named references, as applied in the standing art rejections. The invention, such as illustrated in connection with example Embodiment 1 (see Figs. 1-10) calls for the semiconductor chip to be disposed in a device hole (e.g., 1a1 in Fig. 1) in the tape carrier which includes a base layer and a lead portion bonded thereto (e.g., 1 in Fig. 1) and with one end of a lead of the lead portion being electrically connected to an external terminal (e.g., 2a) of the chip (e.g., 2), the chip having a reduced thickness defined by spin-etching of the back surface to effect a thinning

of the chip to a thickness less than that of the tape carrier. This not only permits the chip to be fully contained in the device opening, but makes it possible for the total thickness of the TCP to be that of the thickness of the tape carrier itself. The polishing process including spin-etching makes it also possible to smooth-out (polish) the back (rear) surface of the chip thereby enabling the chip to offer a "physically robust structure with enhanced resistivity to flexibility/bending stress as well remaining hard-crackable" (see page 7 line 23 to page 8, line 7; page 22, lines 11-25; and page 30, lines 6-14 of the Substitute Specification).

Also according to base claim 1, a further characterizing aspect thereof is that the thinned semiconductor chip is sealed, top and bottom, by a seal resin material such as to achieve a thickness at the resin-sealed location of the device equal to the combined thickness of the base layer (e.g., tape base 1a) and lead portion (e.g., leads 1c). (Page 25, lines 11-13; and page 30, lines 15-21.)

According to this further featured aspect of the invention, it is possible to achieve a total thickness of the TCP to be the same as the thickness of the tape carrier itself. It is submitted, such a scheme as that discussed hereinabove and as specifically called for in base claim 1 and, more particularly, in connection with the corresponding dependent claims thereof, not only was not disclosed nor suggested by Haghiri-Tehrani et al, but, moreover, would not have been suggested even in view of the combined teachings of Haghiri-Tehrani et al with Nakamura and/or Ueda .

Haghiri-Tehrani et al it is submitted, neither disclosed nor suggested a device scheme employing a thinned semiconductor chip inside a device hole in a tape carrier, the thickness of the chip being defined by spin-etching of the back surface of the chip to achieve a thickness thereof less than that of the tape

carrier. Moreover, it is submitted, Haghiri-Tehrani et al neither disclosed nor suggested such a scheme, according to claim 1, which further calls for, among other featured aspects thereof, sealing the thinned semiconductor chip, on both the principal and back surfaces thereof, by a seal resin material such that there is achieved a thickness at the resin sealed location of the device equal to the combined thickness of the base layer and lead portion of the tape carrier. This relates to the earlier discussion, as explained with regard to the example in Fig. 1 of the drawings, although not limited thereto, directed to the relationship of a thickness D1 related to seal resin 3 at the location of the device opening (which has embedded therein the chip 2) to a thickness D2 of the tape carrier 1. Haghiri-Tehrani et al, in Fig. 3, on the other hand, show a scheme in which filler material 7 is poured in window 3 containing the semiconductor chip 4. However, it is noted that the thickness at that window after it is filled with material 7 is not the same as the combined thickness of layer 1 and leads 5, in Fig. 3. From Fig. 3 of the drawings, it is noted that the combined height thickness of film 1 and leads 5, which lie thereover, is greater than the thickness at the location of the window after it is filled with material 7.

With regard to the Fig. 4 embodiment in Haghiri-Tehrani et al, it is noted that the leads 5 are applied to a multilayer film carrier scheme (e.g., 8 and 9) and, moreover, it is noted that the external terminals of the chip and that of the film carriers are located on opposing sides of the device, in clear contradistinction with that according to claim 1, and therefor, also, according to the corresponding dependent claims thereof.

The invention further calls for disposing the semiconductor chip on a "stress neutral plane ..." (see claim 2). This relates to the stress neutral plane "A"

in Fig. 1 of the drawings, which is discussed from page 23, line 25, to page 25, line 5, of the Substitute Specification. The stresses on the chip, and therefore, also on the TCP change depending on the location (height location) of the thinned chip within the device hole. Having investigated this matter thoroughly, the present inventors have found that by positioning the semiconductor chip at a stress neutral plane in the manner as that presently called for, and as further explained in detail in the present specification, the stress applied to the appropriately positioned chip becomes neutral in a direction along the thickness of the chip. Such was, clearly, not discussed nor suggested from Haghiri-Tehrani et al. In fact, absent hindsight reconstruction, such could not have been realized from Haghiri-Tehrani et al's teachings. The invention according to dependent claim 4 further highlights the newly added particularities according to claim 1, discussed above, which have, also, been shown not to be taught by Haghiri-Tehrani et al. Similarly, the further featured aspects of the invention according to claim 1 called for by the dependent claims thereof could not have been rendered obvious, it is submitted, without the benefit of hindsight reconstruction.

Nakamura was applied for its teachings of using solder bumps (e.g., 5) as well as gold bumps (e.g., 1a), the latter as external terminals of the chip 1. The example embodiments illustrated in Figs. 2, 6 and 7 in Nakamura are clearly unlike the scheme called for in present base claim 1 or, for that matter, according to the further dependent claims thereof. Therefore, since Nakamura still would not overcome the deficiencies in Haghiri-Tehrani et al, the invention according to claims 9 and 13 could not have been rendered obvious therefrom.

Likewise, Ueda et al, it is submitted, is also deficient of a semiconductor device scheme as called for in claim 1 and, therefore, even if, *arguendo*, Ueda et

al's teachings were applied to Haghiri-Tehrani et al's disclosure, the invention would still not have been rendered obvious. That is, although Ueda et al disclosed a scheme which employs a low-pressure transfer method of resin into a cavity, the deficiencies discussed above with regard to Haghiri-Tehrani et al's disclosure would still not be overcome even in view of the further teachings in Ueda et al.

Therefore, in view of the amendments presented hereinabove in conjunction with the supportive discussion and arguments presented in these remarks, acceptance and entry therefor of this Amendment as well as favorable consideration of the claims in the presently elected group, including claims 1-2, 4-9, 11 and 13-14, and an early formal notification of allowability of the above-identified application are respectfully requested.

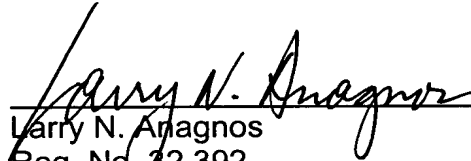
If the Examiner deems that questions and/or issues still remain which would prevent the present application from being allowed at the present time, he is urgently invited to telephone the undersigned representative, at the number indicated below, so that either a telephone or personal interview may be arranged at the Examiner's convenience in order to discuss the same and hopefully resolve any remaining questions/issues present.

A marked-up version showing changes made is enclosed herewith.

To the extent necessary, applicants petition for an extension of time under

37 CFR §1.136. Please charge any shortage in the fees due in connection with the filing of this paper, including extension of time fees to the Deposit Account of Antonelli, Terry, Stout & Kraus, LLP, Dep. Acct. No. 01-2135 (501.37120X00), and please credit any excess fees to such deposit account.

Respectfully submitted,
ANTONELLI, TERRY, STOUT & KRAUS, LLP



Larry N. Anagnos
Reg. No. 32,392

LNA/dks
703-312-6600